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Title

Short-pulse dynamics in optical fibers with a zero-nonlinearity wavelength.

Abstract

All-optical control techniques have attracted interest from the scientific community in the field of optics and photonics due to their potential applications, such as all-optical switching [1, 2]. Furthermore, recently novel optical fibers with a frequency-dependent nonlinearity have been developed, which have been manufactured, for example, by adding dopants such as metal nanoparticles; in particular, these modifications allow the existence of a point in which the nonlinear profile becomes null, called zero-nonlinearity wavelength (ZNW) [3, 4]. Considering those, we studied the spatiotemporal analogies of the reflection and refraction, based on the nonlinear Kerr effect, through an intense pulse can impose a local change in the refractive index acting as a temporal barrier of a weaker pulse traveling at different frequencies and groups velocities. From this concept, we propose a temporal analog of a laser that can be used for distributed measurement applications [5]. On the other hand, we studied short pulse dynamics in optical fibers with a frequency-dependent nonlinearity, particularly those with ZNW. Thus, we analyzed the propagation of fundamental solitons and dispersive waves (DWs), such as Cherenkov radiation and radiation trapping, under the influence of the ZNW [6]. Considering both research lines described, we use the spatiotemporal analogies to study the interaction between an intense soliton and a DW in a media with a ZNW. We found the influence of the position of the ZNW over the interaction, identifying three regions of reflectance and transmittance of the DW through the temporal barrier imposed by the soliton, from which we propose all-optical switching schemes, analog to an optical transistor [7]. Finally, we also introduce all-optical control schemes through adjustable parameters of the DW, to control the temporal delay and frequency shift of the intense pulse, in media with ZNW.

Bibliography

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